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APPLICATION NUMBER: ***60/553,541***
FILING DATE: ***March 17, 2004***

CA/05/403

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No.

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Barrie	KIRK	Ottawa, Ontario, Canada

Additional inventors are being named on the 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

SYSTEM FOR USING CELL-PHONES AS TRAFFIC PROBES

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 11 ☐ CD(s), Number

☑ Drawing(s) *Number of Sheets* 2 ☐ Other (specify)

☐ Application Date Sheet. See 37 CFR 1.76

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Respectfully submitted,

SIGNATURE

TYPED or PRINTED NAME Dilip C. Andrade

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Date March 17, 2004

REGISTRATION NO. 53,942 *(if appropriate)*

Docket Number: PAT 2253P-2

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INVENTOR(S)/APPLICANT(S)		
Given Name (first and middle [if any])	Family or Surname	Residence (City and either State or Foreign Country)
Keith	FAGAN	Ottawa, Ontario, Canada

Number 1 of 1

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Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Barrie KIRK et al.
Examiner Name	
Art Unit	
Attorney Docket No.	PAT 2253P-2

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1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
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2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

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Independent Claims		- 3** =		X	=
Multiple Dependent					=

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1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

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1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
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1806	180	1806	180	Submission of Information Disclosure Stmt	
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1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
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1802	900	1802	900	Request for expedited examination of a design application	

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SUBMITTED BY				(Complete *(if applicable)*)	
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Signature				*Date*	March 17, 2004

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SYSTEM FOR USING CELL-PHONES AS TRAFFIC PROBES

FIELD OF THE INVENTION

[0001] The present invention relates generally to traffic information. More particularly, the present invention relates to the use of assisted Global Positioning System (GPS) enabled cellular phones as traffic probes in a traffic management and control system.

BACKGROUND OF THE INVENTION

[0002] Automated traffic monitoring systems are known in the art, and are taught in references such as Canadian Patent Application No. 2,235,184 and 2,257,438 both of which are incorporated herein by reference.

[0003] Currently traffic management relies upon information collected from infrastructure based sensors such as wire loops under highways that detect the movement of vehicles above them, cameras used to illustrate traffic flow, and transponders such as those used on toll roads. These components require an infrastructure that can be difficult to install after the installation of the roadway. The lack of such sensors results in an insufficient amount information to be useable for a commercial service. Additionally, substantial expansion of government-owned traffic sensor networks is not feasible in many jurisdictions due to the resources required to significantly expand road sensor networks.

[0004] Globis Data Inc. of Kanata Ontario Canada provides DRIVES™ services that are categorized as Traveller Information Services. Traveller Information Services consists of user services designed to use advanced systems and technologies to manage information to help drivers decide when to drive and the route to drive, as well as opportunities to reserve rides and other traveller services. This category has four specific user services: Traveller Information; Route Guidance and Navigation; Ride Matching and Reservation; and Traveller Services and Reservations. DRIVES™ provides travellers with information prior to their departure to assist them in making mode choices, travel time estimates, and route decisions based on route planning and congestion information.

[0005] Many drivers have expressed a desire to have advance notification of any impairment to their movement around the city, thereby allowing them to choose a route that will be more efficient at a specific time of day. These users are interested in the current speed of traffic along major routes, any congestion due to traffic volume, accidents or planned outages that might impair progress, weather conditions etc. Traffic congestion in our major cities will undoubtedly get worse, and there is strong interest by users in receiving more detailed real-time traffic information. In a U.S. survey conducted by Driscoll-Wolfe, 28% of respondents making 1 or more cell-phone calls per month said they would be willing to pay a fee for a location-based traffic information service.

[0006] To be able to satisfy all these requirements, traffic information must be complete, accurate and timely. In addition, the information must be presented in a fashion that is readily available and can be safely delivered. One critical element is the amount of traffic data available to the user. The current services uses real-time information provided by the Transportation departments. The current level of traffic information from traffic departments is typically considered to be insufficient for a commercial service. Substantial expansion of government-owned traffic sensor networks is not feasible because governments simply do not have the resources to significantly expand their road sensor networks.

[0007] One solution is to find a technology that will allow traffic information to be gathered. Attempts have been made to use cellular phones as traffic probes, triangulating the location of a phone based on the received signal strength at a variety of cellular sites. This triangulation is an inaccurate measure of location, as the strength of a digital cellular signal is typically reduced at it source so that it arrives at a nearby cellular tower with the same strength as any other signal. The intentional reduction in signal strength often makes the use of different cellular site readings difficult as the cellular sites further from the handset receive very faint signals. As a result, the triangulation of a cellular phone cannot resolve a location with sufficient accuracy to be able to determine which side of a highway a cellular phone is on. In other instances, a system cannot differentiate between a cellular phone on a service road adjacent a highway and a cellular phone on the highway. As a result cellular triangulation is considered to be too inaccurate for use as a traffic probe. The use of the

timing differential between the receipt of the signal at different cellular sites is equally ineffective as a triangulation data source.

[0008] The provision of accurate, relevant and timely road conditions information has long been recognised as of value to travellers and traffic system management personnel. Currently, the state of practice with respect to the provision of traffic information is rather limited. Congestion information is provided at a very small number of fixed points along selected major freeways (i.e. changeable message signs) and qualitative information is provided periodically over AM and FM radio. While these methods of disseminating traffic information are of some value, they are significantly limited in terms of spatial coverage, accuracy, and timeliness of delivery to the traveller.

[0009] The most significant hurdle preventing the development and deployment of more robust and capable traveller information systems is the difficulty in obtaining traffic condition data. Infrastructure based traffic surveillance systems, such as in-road loop detectors, video imaging systems, and transponder based systems (i.e. Hwy 407 in Ontario), are very expensive to deploy and maintain over a large network. Furthermore, jurisdictional issues associated with private sector firms installing traffic surveillance equipment on public roadways and access to the right-of-way makes this approach particularly difficult.

[0010] It is, therefore, desirable to provide a traffic monitoring system that makes use of a technology that allows traffic information to be gathered..

SUMMARY OF THE INVENTION

[0011] There is a need by many government transportation agencies and by drivers for better real-time traffic information. The present invention seeks to serve such a need.

[0012] It is an object of the present invention to obviate or mitigate at least one disadvantage of previous traffic monitoring systems employing traffic probes.

[0013] In a first aspect, the present invention provides a system and method for monitoring traffic flow. The method includes the step of receiving location based information from assisted GPS enabled cellular phones, filtering the received information to remove aberrant values, and determining a traffic flow on the basis of the filtered information. This information is then displayed to permit monitoring. The system includes a location based service (LBS) interface, a filter, a traffic flow engine and an interface, for carrying out the

steps of the method described above. In a presently preferred embodiment, the LBS interface interfaces with algorithms implemented in software to provide position filtering, and the traffic flow engine allows for the calculating of traffic speed.

[0014] Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

Fig. 1 is an illustration of a map for monitoring traffic flow and congestion;

Fig. 2 is an illustration of a map for monitoring traffic flow and congestion displayed on a small form factor device; and

Fig. 3 is an illustration of an SMS-based text message conveying traffic congestion information.

DETAILED DESCRIPTION

[0016] Generally, the present invention provides a method and system for monitoring and managing traffic flow and congestion.

[0017] It is widely recognized that the best way to obtain extensive traffic speed and congestion information across a city is via the use of "floating probes" that form part of the traffic flow. Such probes, as part of the traffic flow, allow for real time analysis of traffic positioning and flow. The distribution of such probes into a traffic flow ideally does not require inserting test cars into the traffic flow, for both environmental and traffic congestion reasons. To allow for a large number of probes integrated with the traffic flow and providing relatively accurate positioning, the present invention makes use of assisted GPS enabled cell-phones as traffic probes. Wireless carriers are planning the deployment and/or actually deploying Location Based Service (LBS) infrastructures for Enhanced 911 (E-911) and commercial applications. LBS is an ideal platform for the use of cell-phones as traffic probes. The enabling technology for this is based on a legal requirement in the U.S. that cell-phone companies must be able to determine the location of callers to 911

[0018] There are three relevant User SubServices defined in the ITS architecture, they are ATIS1 Broadcast Traveller Information, ATIS2 Interactive Traveller Information and ATMS01 Traffic Network Flow Monitoring.

[0019] ATIS1 Broadcast Traveller Information provides the user with a basic set of ATIS services; its objective is early notification. It involves the collection of traffic conditions, road conditions, advisories, general public transportation, toll and parking information, incident information, air quality and weather information, and the near real time dissemination of this information over a wide area through existing infrastructures and low cost user equipment (e.g., FM sub-carrier, cellular data broadcast). Different from the market package ATMS6, Traffic Information Dissemination, ATIS1 provides the more sophisticated digital broadcast service. Successful deployment of this market package relies on availability of real-time traveller information from roadway instrumentation, probe vehicles or other sources.

[0020] ATIS2 Interactive Traveller Information provides tailored information in response to a traveller request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveller based on a submitted profile are supported. The traveller can obtain current information regarding traffic conditions, road conditions, transit services, ride share/ride match, parking management, and pricing information. A range of two-way wide-area wireless and wireline communications systems may be used to support the required digital communications between traveller and the information service provider. A variety of interactive devices may be used by the traveller to access information prior to a trip or en-route, including phone, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles or other means.

[0021] ATMS01 Traffic Network Flow Monitoring includes traffic detectors, road condition sensors, environmental sensors, other surveillance equipment, the supporting field equipment, and wireline communications to transmit the collected data back to the centre which uses the data (traffic management, maintenance management, or archive data management). The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this market

package enables the operators of the centres to monitor traffic environmental and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analysed and made available to users and the Information Service Provider Subsystem.

[0022] The Logical Architecture defines what has to be done to support the User Service, i.e. the traveller information. It defines the processes that perform the data gathering, processing and distribution functions and the data flows between these processes. The Logical Architecture of the present invention consists of Process Specifications, Data Flow Diagrams, and Data Dictionary Entries. The benefit of this approach is that the Logical Architecture will be easily scalable from small scale implementations to large regional systems.

[0023] The Physical Architecture takes the processes identified in the Logical Architecture and assigns them to Subsystems, and it provides organizations with a physical representation of the important ITS interfaces and major system components. The Physical Architecture also provides a high-level structure around the processes and data flows defined in the Logical Architecture.

[0024] An assisted GPS enabled cellular phone based traffic probe system provides improved productivity directly due to a reduction in the time wasted in congested traffic, assists in reducing air pollution because vehicles reach their destination faster; allows them to spend less time idling in congested traffic; and can provide improved real-time traffic information for government transportation agencies that will help them improve traffic flows in their jurisdictions.

[0025] To use assisted GPS enabled cellular phone based traffic probes, the system first determines the location of the cell-phone. This location is compared to a map to determine if it is on a highway or road of interest. This is known as "geo-fencing". The system then compares to the position of a particular traffic probe to a previously known position a defined amount of time ago and estimates the speed of thevehicle on the basis of the distance travelled over the time interval. In this step, the distance between the two samples can be determined to be greater than the simple crow-flies distance if it is known that the road curves or has other topographical features. In another step, statistical methods

are used to identify vehicles that have speeds that are significantly different from the others in that section of highway. For example, if we take a section of a highway, and if 10 probes are moving at or above the speed limit and one is stationary, then it is reasonable to assume that the stationary probe is in a car that has broken down for one reason or another. That probe's speed is therefore filtered out. This can also be used to determine that traffic is flowing at different speeds in different lanes, or in core and collector lane groupings. Finally, all the useful traffic data in a given direction within a given highway zone is optionally averaged to yield a more precise figure for the follow of trafic in that zone and in that direction.

[0026] It is proposed that mobile phone location referencing systems (LRS) be used to track the travel speed of a sample of mobile phones. Tracking would be anonymous, so that there is no possibility to associate any phone with a person. In a presently preferred embodiment the anonymity of the system is a one-way relationship, where cellular phone users know that their positions are being tracked, using an opt-in system, but the system of the present invention does not receive identifying information. However, one skilled in the art will appreciate that the system could just as easily be implemented by a cellular carrier providing the position of all cellular handsets, whether or not the cellular phone user has agreed or not.

[0027] Obtaining traffic information in this manner has several significant advantages over other approaches. First, the number of potential probes (e.g. phones in vehicles) is very large. Second, these probes are sufficiently dispersed throughout the network that the number of active probes on any specific road segment in any given interval (say 15 minutes) is likely to be sufficient to provide travel time (or average speed) estimates of adequate reliability. Third, this approach is low cost, as the vehicle side infrastructure (i.e. wireless device) is already owned by the traveller, and the hardware required by the wireless operator will already be in place to meet other needs (e.g. E911 requirements). There are, however, a number of technical issues that must be addressed. The first of the issues is that the location of the mobile phone is not known with absolute certainty. The error associated with the estimated location of the mobile phone is a function of the LRS and may vary with topography and other factors.

[0028]

[0029]

[0030]

[0031]

[0032] The methodology for developing the algorithms for processing location data is outlined below:

[0033] 1. Identify the characteristics of the LRS. In particular, accuracy of the location data, variations in error as a function of network topology, etc., and issues/constraints regarding polling frequency.

[0034] 2. Identify the most appropriate map matching algorithms for associating mobile unit locations with road segments.

[0035] 3. Construct a road network database for the selected test area that is suitable for map matching.

[0036] 4. Develop mathematical relationships/models for estimating the current average roadway segment travel time (or average speed) on the basis of the cell phone location data.

[0037] Several considerations must be taken into account in employing assisted GPS handsets as traffic probes. The first of these considerations is the privacy of the cellular phone owner. To allow for LBS, cellular provides provide two options for location sensitivity. The first option is for location sensitivity to be off, so that the location will be hidden from network and any application except 911 services. The alternate option is to allow the location be ON and accessible to the network and associated applications. To encourage use of LBS cellular phones are typically provided with a default of ON. This allows for handset owner opt-in. Users can give their consent to have their cell-phone tracked for this purpose. Options include a box on the cell-phone service agreement that must be checked to allow this or the use of the optional setting on cell-phones that was described earlier. Handset owners can also be provided the option of being given a discount to the service as an incentive to have their cell-phone tracked.

[0038] As all information is routed through a wireless carrier, it is possible to further ensure privacy by having the data anonymized prior to submission to the traffic management system. Any information that could be used to identify a cellular subscriber can be stripped out, and replaced with consistent information that allows the system to determine that a

cellular phone at one location is the same phone that was at a previous location a fixed interval ago. This anonymous identifier is ideally consistent across cellular sites so that the tracking of traffic flow is not interrupted at cell site interfaces.

[0039] To further provide privacy, the system can be established to prevent archiving of information on specific cellular phones. This ensures that even if the privacy firewall fails, the lack of any archived data on each user's specific movements prevents a potential leak of accumulated cell phone user information. The archiving of processed traffic speed information will be permitted because it is an amalgamation of many drivers' movements. This is analogous to census data: the data on individual people is confidential, but the processed statistical data is frequently released into the public domain.

[0040] After collecting the information, the system can distribute it through a number of channels. The traffic patterns can be accessible in a database, and a variety of interfaces, such as digital radio broadcasts, website maps, or text messages can be easily provided. Additionally an interactive voice response system can be connected to the database to allow a customer to call in and receive automated reports based on either saved travel profiles or dynamic requests.

[0041] An example of a web based map with traffic conditions illustrated is provided in Figure 1. A similar traffic condition display provided by a wireless connection enabled personal digital assistant is illustrated in Figure 2. An SMS based text message of traffic conditions is illustrated in Figure 3

[0042] The above-described embodiments of the present invention are intended to be examples only. Alterations, modifications and variations may be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention, which is defined solely by the claims appended hereto.

What is claimed is:

1. A system for monitoring traffic flow comprising:

a location based services interface for receiving, from a cellular network, location based information for at least one assisted GPS enabled cellular phone traffic probe;

a filter for filtering the received location based information to remove aberrant location information;

a traffic flow engine, for determining traffic flow based on the filtered location based information; and

an interface, for receiving the determined traffic flow from the traffic flow engine and for displaying the determined traffic flow to permit monitoring.

2. The system of claim 1 wherein the filter is implemented as software executed by a microprocessor.

3. A method of monitoring traffic flow comprising:

receiving location information corresponding to the location of at least one assisted GPS enabled cellular phone;

filtering the received location information to remove aberrant location information;

determining a traffic flow based on the filtered location based information; and

displaying the determined traffic flow to permit monitoring.

ABSTRACT

A system for traffic and congestion monitoring and management is disclosed herein, using GPS enabled cellular phones as traffic probes.

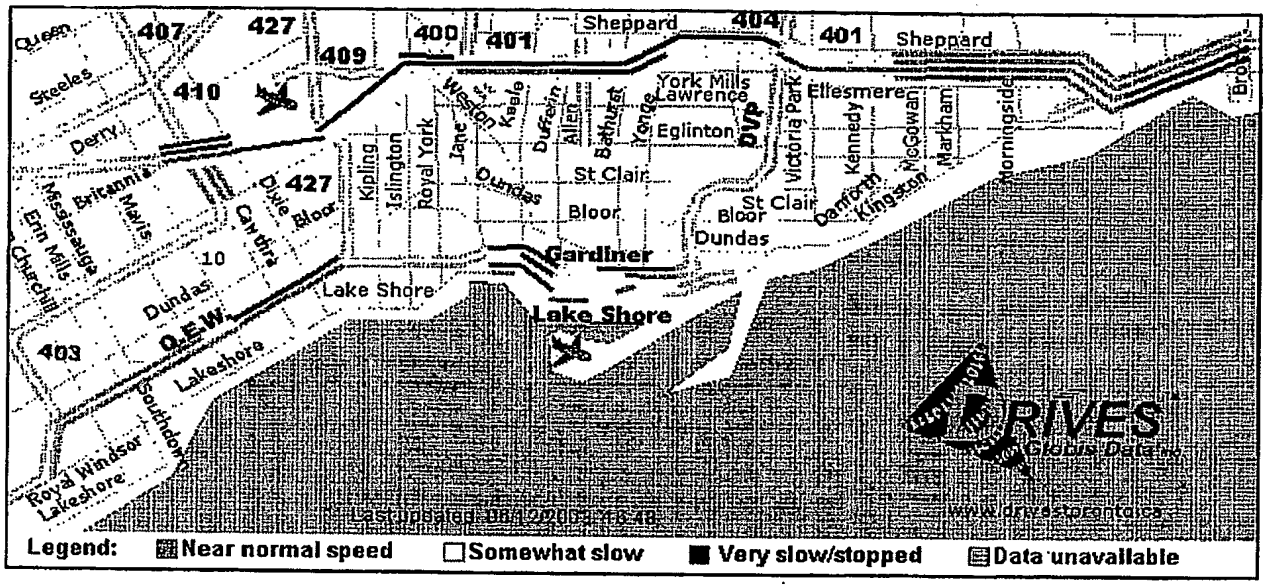

Figure 1

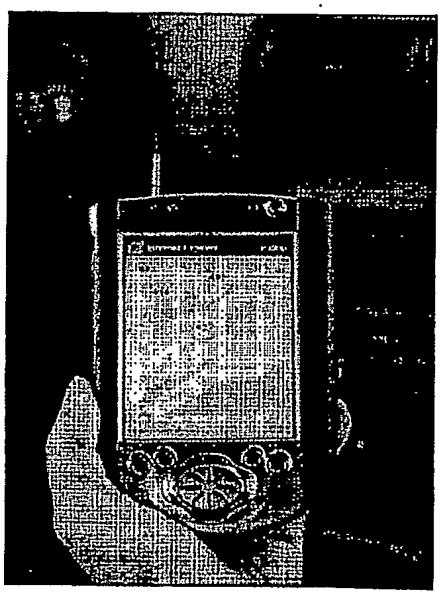

Figure 2

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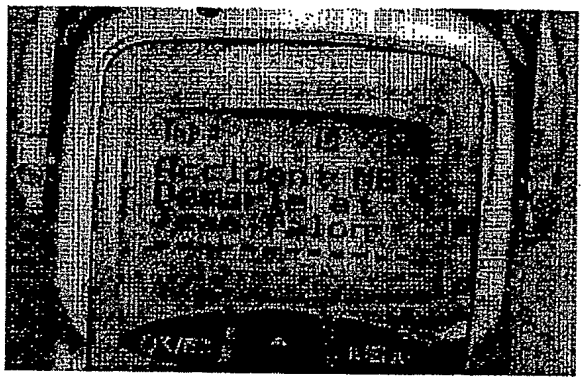

Figure 3